

Communication Options “Lessons Learned”

**FEMP
Advanced Metering
Solutions
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□ Comms Issues

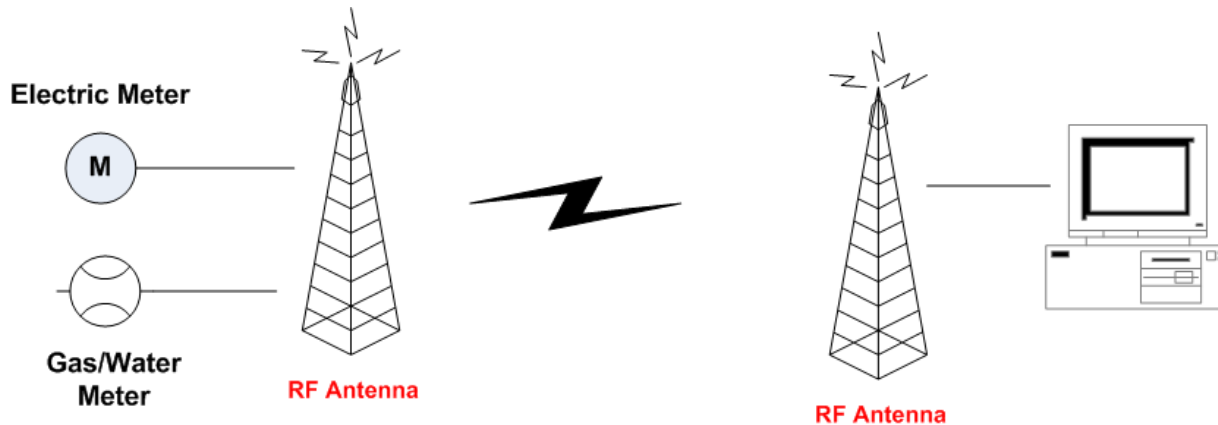
- Wireless
- Non-wireless
- Data Through-put
- Security
- Reliability

□ IT Issues

- Data Collection / Report Formatting
- Alarm Management
- DUERS Reporting
- State Commission Compliance
- UDC Interfaces



Wireless Communications

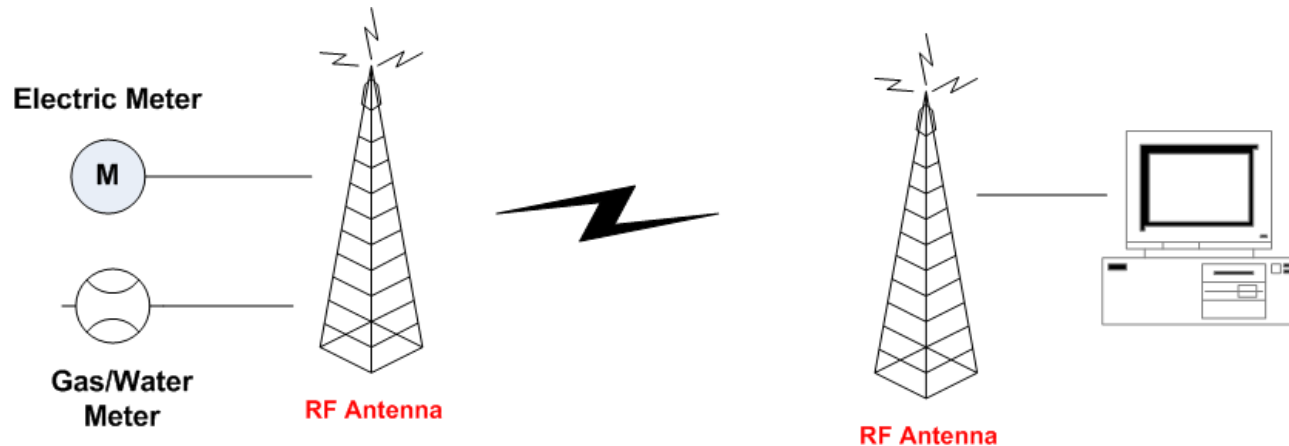


Advantages of Wireless :

- Low installation & Operating Costs
- Minimal Disruption to Operations
- Equipment Longevity
- Swift Deployment
- Easy Configuration -

Many wireless systems are plug- and- play

Wireless Communications



Historical Challenges With Wireless :

Wireless has had a rocky past and typically has not performed well, especially in industrial environments.

- Signal Echo and/or Noise
- Channel Sharing and Interference
- Industrial Protocols Not Supported
- Distance
- Security

Wireless Communications

New Methods & Technologies Solve Some Wireless Issues

Echo, Noise & Channel Interference

Several transmission and modulation schemes exist to counter the effects of echo, noise, and channel sharing.

FHSS (Frequency Hopping Spread Spectrum)

Data is transmitted on a single channel at a time, but the channel is rapidly and constantly changing or "hopping". Requires low bandwidth.

DSSS (Direct Sequence Spread Spectrum)

Data is transmitted simultaneously over every available channel, making it a bit more reliable in "noisy" environments, but is bandwidth intensive.

Wireless Standards:

| | Wi-Fi | Bluetooth | ZigBee | PR F |
|----------------------------|--|--|-------------------------------|---|
| Frequencies | 2.4GHz and/or 5GHz | 2.45GHz | 915MHz(US) 2.4GHz (global) | 900MHz(US) 2.4MHz (global) |
| Channels | 16 @ 2.4GHz 80 @ 8GHz | 79 Class1=1m Class2=10m Class3=100m | 10 @ 915MHz 26 @ 2.4GHz | 16 to 79 (can be customized) |
| Range (Indoor) | 70m | | 20m | 1000m |
| Range (Outdoor) | 160m | 100m | 100m | 40 miles (with high-gain antenna) |
| Data Rate (Max) | 54Mbits/s (with12Mbits/s typical) | 3Mbits/s | 250Kbit/s | 721Kbit/s to 72Mbit/s |
| Transmission Scheme | DSSS | Adaptive FHSS | DSSS | FHSS or DSSS |
| Power Sources | Wired | Battery/ Wired | Battery/ Wired | Battery/ Wired (industrial power source compatible) |
| Uses | Cable replacement, large data transfer, networking | Short distance cable replacement | Monitoring Controlling | Cable replacement, Monitoring, Controlling, Data Transfer |

Pros/Con of Differing Technologies:

Wi-Fi (IEEE 802.11 b/g/n)

❑ Pros –

- Widely used for its high data transfer rate abilities (max throughput of up to 54 Mbit/s with 12Mbit/s being typical).

❑ Cons –

- Excessive overhead in terms of power consumption, software, processor power
- Short ranges (160m max)
- Size of physical components
- Security (lack thereof)

Pros/Cons of Differing Technologies:

Bluetooth (IEEE 802.15.1)

□ Pros –

- Small physical size and instant network setup.
- 3 classes allow Bluetooth to move data anywhere from 3m to 100m away.

□ Cons –

- Bluetooth has a relatively high duty cycle (especially in 2.0)
- Minimal data throughput (currently a maximum of 3 Mbit/s is possible).
- Requires a fairly defined line-of-site because of its low penetration qualities.

Pros / Cons of Differing Technologies:

ZigBee (IEEE 802.15.4)

❑ Pros –

- ZigBee more power-friendly than Wi-Fi and Bluetooth (advanced sleep and sniff abilities)
- High penetration ability
- Smaller physical footprint than Bluetooth.

❑ Cons –

- Zigbee has low data rates - up to 720 kbit/s
- Poor interoperability.

Pros/Cons of Differing Technologies:

Proprietary RF (non-standard)

☐ Pros –

- Proprietary RF (PRF) can be customized
- Interference issues virtually disappear
- More power-friendly
- Costs can actually be lower.
- Operates in both 900Mhz & 2.4Ghz frequencies

☐ Cons –

- Does not provide interoperability with any of the established wireless standards
- Considered by some to create vendor lock-in.

Wireless Implementation:

Range Considerations

- Transmit Power
- Receiver Sensitivity
- Line of Sight (LOS)
- Data Volume

Wireless Implementation:

Penetration and Congestion Considerations: (900MHz vs. 2.4GHz)

900 MHz

- 900MHz has a greater physical barrier penetration and is far less popular (thus making the frequency range less crowded)
- 900MHz communications can be extended to around 40 miles, across terrains.
- If high data transfer rates are needed, this slower frequency may not be adequate.

2.4 GHz

2.4 GHz has become a fairly crowded frequency & has a tighter, shorter wave length

Antenna Considerations

Antenna selection will depend on communication needs
System array and range being the biggest factors.

Types of Antenna/Configurations:

Directional –

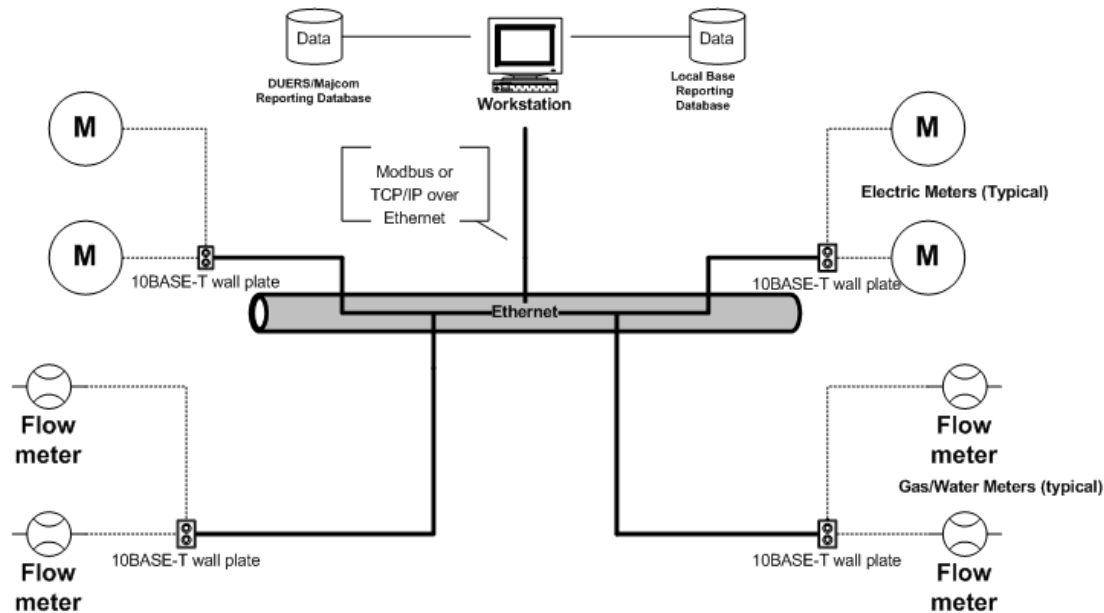
- Sends and receives the signal in a single direction.
- Interference can occur at any point within the spectrum.
- Largest range

Omni Directional-

- Sends and receives the signal in a linear radius.
- Allows the largest number of nodes.

Point to Point and Multipoint

Wired Communications



Advantages of Wired :

- Data Security
- Integrity Operations
- Equipment Longevity
- Higher Data Transfer Rates
- Std. Comm Protocols

Disadvantages of Wired :

- Higher Installed Costs
- Disruption during Installation

Fiber Optics

□ Pros –

- Widely used for its high data transfer rate abilities
- High data security
- Ambient noise resistant
- Electric code installation flexibility

□ Cons –

- Expensive
- May require new conduits
- Specialty labor
- Size of physical components
- May need repeaters

Ethernet/TCP-IP

❑ **Pros –**

- Common Industry std. and instant network setup.
- Higher Data Rates
- Interfaces to other systems (modbus, etc.)

❑ **Cons –**

- Bus Traffic and data “throughput” congestion
- Data security
- Other IT departments may want to control

RS-232/RS-485

□ Pros –

- Common industry std. and instant network setup.
- Good signal integrity
- Interfaces to other systems (modbus, etc.)

□ Cons –

- Data throughput issues
- Size of physical components
- Security (lack thereof)

PhoneLines

❑ **Pros –**

- Ease of comm setup.
- Minimal wiring & conduit
- Network accessibility

❑ **Cons –**

- Data security
- Other departments may want to control
- Signal integrity

Broadband over Powerline (aka Powerline Carrier)

❑ Pros –

- Used for its high data transfer rate abilities
- Utilizes existing wiring as the medium
- Lower wiring/routing costs

❑ Cons –

- Short range
- Size of physical components
- Security (lack thereof)
- Need repeated
- Signal Integrity & interference

Real World Lessons Learned:

“Soft spots”

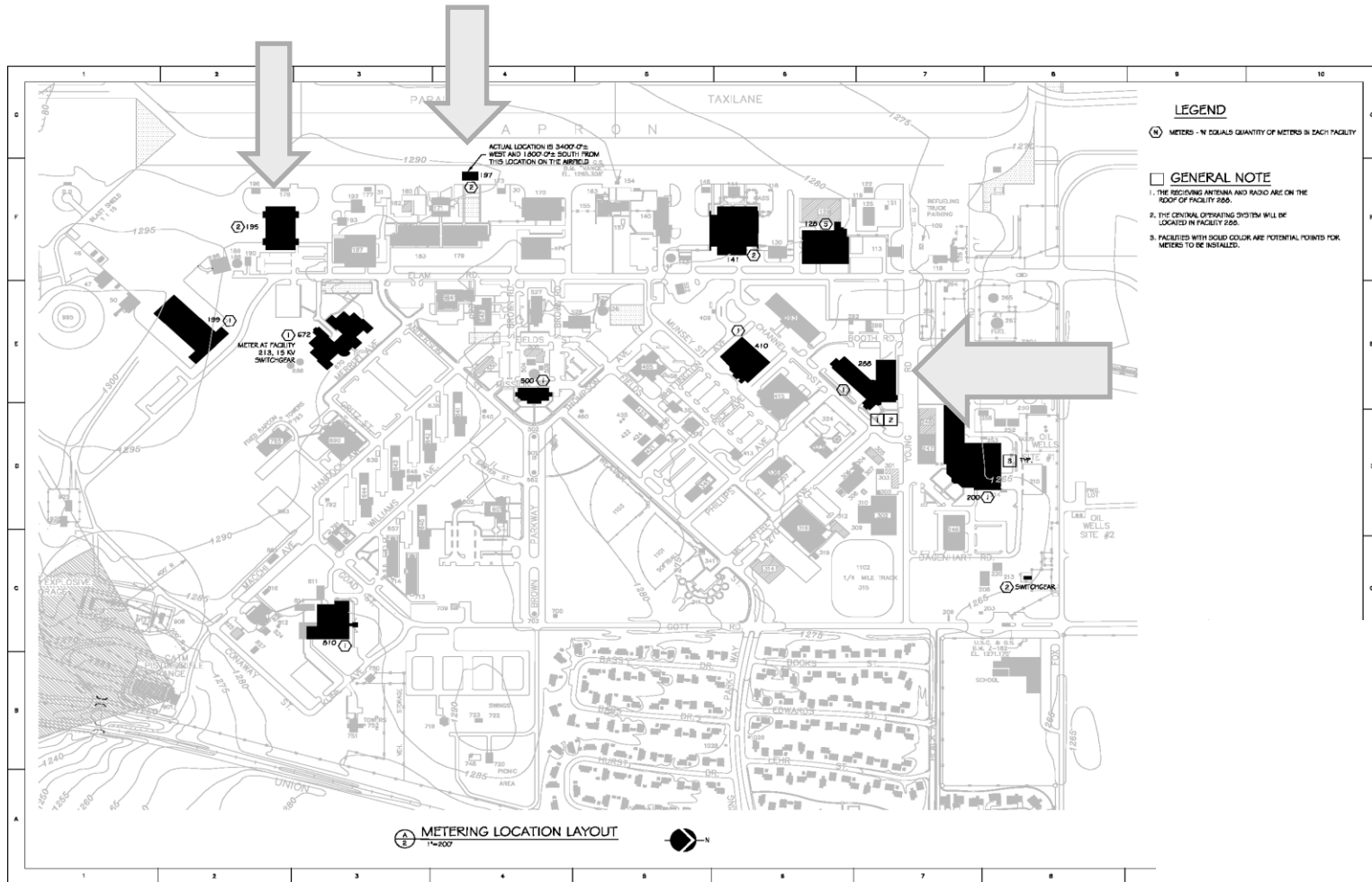


**These
are not
necessarily
compatible!**



“Open” port

Real World Lessons Learned:



Thank You

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